The segregation of generations: ancestral groups in Sydney, 2011

Abstract

Most models of immigrant minority enclave formation in cities represent their situation as relatively transient elements in urban residential mosaics. As minority group members become both economically integrated and socially-culturally assimilated into the host society, so they move away from the enclaves where they initially concentrated. Such shifts are especially likely among the second and later generations of group members, who are more likely to overcome the disadvantages experienced by many of the original settlers with regard to human capital. This paper evaluates that model using data on the residential distributions of three generations of those claiming membership of one of nineteen different ancestral groups in Sydney in 2011, at four nested spatial scales, deploying a recently developed inferential method for evaluating the intensity of residential segregation. The findings are not consistent with the model: in general, members of the second and third generations in any ancestral group are as segregated as the first generation (that is, those born outside Australia) at both regional and neighbourhood scales.

KEY WORDS *spatial scales; residential segregation; assimilation; ancestral groups; generations; Sydney*

Most models of minority—usually immigrant minority—enclave formation in cities represent those components as relatively transient elements in urban residential mosaics. As minority group members become both economically integrated and socially-culturally assimilated into the host society, so they move away from the enclaves where they initially concentrated, with more dispersed geographical distributions. Such shifts are especially likely in the second and later generations of any group, who are more likely to overcome the disadvantages experienced by many of the original settlers with regard to human capital. As they obtain the educational qualifications and cultural characteristics necessary for labour market success, and are better able to negotiate the social and cultural mores of the host society, they no longer feel a strong need to live in neighbourhood enclaves where their ancestral cultural norms dominate: structural (socio-economic and socio-cultural) assimilation is correlated with spatial assimilation.

This sequence thus suggests that whereas first generation immigrants are likely to be concentrated in enclaves where they form a large proportion of the local population (usually in inner city districts where housing is relatively cheap), their second-generation offspring are less likely to live there. Instead a substantial proportion of them – the economically more 'successful' and/or socio-culturally more 'assimilated'—live elsewhere in the city (as outlined in early studies by Cressey, 1938, and Lieberson, 1961). However, many, if not most, are likely to move to districts and neighbourhoods close to the first generation enclave, in part enabling them to retain their kinship and institutional links to that neighbourhood and in part because most urban residents' search spaces are relatively confined around their existing homes. But the neighbourhoods they move into are likely to be more mixed in their population composition than that of the original enclave. Members of the third generation—

the grand-children of the original immigrants—by the same reasoning are likely to be even more widely spread through the urban residential mosaic.

This representation of the likely geographies of minority group residential patterns has a long history in social science appreciations of urban structures, with major contributions coming from the 1920s–1930s Chicago School of urban sociology and their successors (as reviewed, for example, in Johnston, 1969; Taeuber, 1968). Those writers and a wide range of subsequent others have provided substantial circumstantial evidence of these patterns in American and other cities—with some partial exceptions, such as the long-standing separate ghetto-like concentrations of African-Americans. Thus spatial assimilation theory argues that immigrants will leave the initial enclave areas of concentration over time or generation as they become more integrated into their new society.

But there are few substantive, quantitative studies of the anticipated patterns there, largely because of the absence of relevant data, most notably in regular censuses. Detailed studies based on a range of sources have identified patterns conforming to the model, however (for example Firey, 1945, and Simirenko, 1964). Fong and Hou (2009, pp.413–4) summarise this literature by suggesting that:

> residential integration is cumulative in nature, as successive generations achieve higher levels of residential integration with the majority groups. This incremental improvement is related to the increase in socioeconomic resources of later generations. It is also related to the higher return on these socioeconomic resources, in the form of improved locational outcomes.

They successfully tested this argument using Canadian data on three major recent immigrant groups in cities there—South Asians, Chinese and Blacks; holding constant other factors—such as socioeconomic resources—they found that 'groups experience residential integration across generations' (p.418). However, in a previous study they noted differences between European and Asian or Black immigrants and argued for a cautious approach to any application of the spatial assimilation model (Fong & Wilkes, 1999). Nevertheless, Edgar (2014) has reported similar findings for Australian cities to Fong and Hou's (2009) for Canadian cities, as also did Andersen (2010; 2016) for Danish cities; Edgar showed that with structural assimilation, immigrants to Australian cities also become more spatially assimilated, moving out of ethnic enclaves to other parts of the city less culturally segregated from the host society. But, echoing Fong and Wilkes (1999), Brown's (2007) study of the multi-generational incorporation of Mexican immigrants in Los Angeles suggested a more complex relationship between structural and spatial assimilation: a linear correlation between structural and spatial assimilation may not equally apply to all, and substantial spatial assimilation may not occur until the third generation. Importantly too, in none of these studies was there any indication of actual patterns of dispersion across the city. Zorlu and Mulder (2010) found a similar pattern in the Netherlands among those they termed 'nest-leavers for union formation' (such as second generation members getting married and setting up independent homes) but not those leaving the parental home for shared living arrangements; the latter group were more likely to remain in the same neighbourhood as their parents and the former to move further afield.

One feature of all of these studies—indeed of virtually all studies of ethnic residential segregation—is that they examine the pattern of segregation at a single spatial scale only. This is usually the smallest for which census data are available in sufficient detail and volume, so that the studies focus almost exclusively on neighbourhoods—the relatively small locales (in many cases housing less than 500 persons) that make up the detailed urban residential mosaic. This may obfuscate patterns of intra-urban dispersion because, as Fowler (2015) has recently argued, segregation should be viewed and analysed as a multi-scalar phenomenon. Individuals and households make their residential location decisions at a variety of spatial scales, and segregation measurements should take this into account—as suggested by Fischer *et al*. (2004), Reardon *et al.* (2008) and Östh *et al.* (2015). But a feature of all these essays into multi-scalar measurement is that they treat each scale as independent of all others. An alternative approach, which assesses the degree of segregation at each of a series of spatial scales net of any segregation at larger scales addresses this problem (Jones *et al.*, 2015). It may be, for example, that members of an immigrant group choose to live in one sector of a city rather than others and, within that sector, may prefer certain neighbourhoods over others, or they may be evenly distributed throughout that sector (that is, they are relatively segregated at the macro-scale but not also at the micro-scale). The method deployed here—as illustrated in a case study of changing ethnic segregation in Auckland (Manley *et al.*, 2015; see also Maré *et al.*, 2015)—identifies the intensity of segregation at the sector scale and then, holding that constant, its intensity at the neighbourhood, within-sector scale; it expresses the relative importance of each.

Application of this multiscale approach to segregation measurement to the geography of Sydney's ethnic group populations for all generations combined (Johnston *et al.*, 2016a) has not only illustrated the method's usage in a multi-ethnic city but also clearly linked that measurement procedure to the theory of residential decision-making. It has shown that each of the city's minority ethnic groups is concentrated in a few macro-scale regions of the urban fabric only and then also, within those regions, in particular micro-scale neighbourhoods.

That paper dealt with each of Sydney's ancestral groups as a homogeneous entity. This paper builds on it by evaluating the degree of segregation of each of three separate generations—those born overseas, those born in Australia to parents born overseas, and those born in Australia to parents also born in Australia but who continue to claim a non-Australian ancestry—across a range of Sydney's immigrant ethnic groups.

Sydney – a multi-ethnic city

Australia has experienced a sequence of separate migration streams since it was first settled by Europeans in the late eighteenth century. For the first century and a half, those streams were dominated by immigrants from Great Britain and Ireland. After World War II, when immigration from those sources (although both encouraged and subsidised) was insufficient to supply the needed skilled and unskilled labour for Australia's burgeoning industrial economy, substantial streams from continental Europe—especially Greece, Italy, Malta and the former Yugoslavia—were established, but the 'White Australia' policy precluded any immigration from Asia. That ethnically restrictive policy was ended in the 1970s, and substantial flows then commenced from a range of Asian countries. This latter period largely coincided with the onset of global economic restructuring and a policy shift in Australia from a focus on unskilled to skilled (that is, professional, semi-professional and managerial) immigrants from the early 1980s. Equally important were significant in-flows of refugees, notably from Vietnam in the mid-to-late 1970s, and subsequently from a number of Middle Eastern countries.

The existence of these various migrant streams has been recognised in recent Australian censuses, which ask respondents about their ancestry. From the responses it is possible to identify those who migrated to the country and from where (the first generation), those for whom one or both parents were born elsewhere but were themselves born in Australia (the second generation), and those whose parents were also born in Australia (the third generation). (A minority—30 per cent—claimed multiple ancestries and, as typical in the use of these data, they have been double-counted in the analyses.) With such data the number of first, second and third generation Italians can be identified, for example. Where they live can also be mapped, at a variety of spatial scales, using the Australian Bureau of Statistics Census TableBuilder facility, and from such mapped data the degree of intergenerational segregation or spatial assimilation can be assessed.

These census data have been analysed in a variety of ways to identify the extent to which different generations are concentrated in separate parts of Sydney. Burnley (1994, 1996), for example, mapped their distributions in the 1986 census and identified separate first and second generation geographies, which he summarised in a schematic diagram; he has also mapped the changing geographies of Lebanese, Vietnamese and Chinese settlers there (Burnley, 1982, 1989, 2002; see also Wilson, 1989). All of these papers provide cartographic and tabular data displaying patterns consistent with the general model regarding generational differences in degree of segregation, but rarely measure it (*cf.* Burnley, 2002); a later paper concluded, for Italians, that there 'was dispersal but also regionalisation of second and third generation movement, and the maintenance of moderate residential concentration (but not segregation) of sections of the adult second and third generations' (Burnley, 2005, p.391)—a finding consistent with the multi-scale thesis of residential location-decision-making developed here. Khoo *et al.* (2002, pp.61–62) link this to structural assimilation, especially among immigrants from Asia. Similarly, in a detailed cartography of Polish settlement in

Melbourne, Forrest and Kusek (2016, p.242) show ‘upwards intergenerational progression’ away from more socially and economically disadvantaged suburbs.

Although Edgar (2014) evaluated the intensity of segregation quantitatively at one, relatively coarse spatial scale only for separate generations across a range of ethnic groups in both Sydney and Melbourne (Statistical Area level 2—SA2s—about which see below), her focus was not on the nature of those geographies per se, but rather on how the summary index of dissimilarity for each group correlated with various aggregate measures of its human capital (qualifications, income, English-language ability, and unemployment, i.e. structural assimilation). She found that, holding constant those measures (higher incomes, better qualifications and better command of English were all negatively associated with segregation; higher unemployment was positively related), later generations were less segregated—that is, were more widely distributed across the 188 SA2 areas in Sydney and 178 in Melbourne—although some groups deviated from this general trend. In Sydney, for example, there was ‘slower than expected spatial assimilation among the third-plus generation’ (p.376) for Lebanese and Russians.

This paper reports on analyses of the residential geographies of nineteen separate ancestral groups in Sydney, selected to represent the different migration streams to Australia over the last century (Table 1). Those from Ireland and the UK are the longest established, and have by far the largest third-generation components; the German, Greek and Italian groups also have substantial numbers in the third generation. Most of the Asian groups, whose original immigrants arrived in Australia within the last few decades, have only small numbers in the third generation, and the analyses focus mainly on their first and second generations only. We have also included those claiming Jewish ancestry, as a special group within the minority populations, and have analysed the geography of those claiming no non-Australian ancestry as a baseline comparator: the latter are not divided generationally, of course.

<Take in Table 1 around here>

Data were collated for those aged 20 and over in each generation only: younger members of the second generation, for example, were likely to be living in their first-generational parental home. By analysing this adult population only, the focus is on those most likely to be living apart from their parents and having made their own residential location decisions.

Data on the distribution of the nineteen groups have been assembled at four spatial scales, ranging from the macro-scale (regions—Statistical Area level 3 or SA3), through two meso-scales (districts—SA2—and suburbs—SSC—respectively), to the micro-scale (neighbourhoods—SA1). The number of areas in each, with their mean populations in 2011, was:

- regions (sub-metropolitan labour market areas)—41 (99,079);
- districts (community areas seen as interacting socially and economically)—217 (18,720);
- suburbs (social areas as designated by the NSW Geographical Names Board)—555 (7,319); and
- neighbourhoods (equivalent to the previous Collector Districts)—9,098 (477).

Most measures of residential segregation of ethnic groups within an urban mosaic use descriptive statistics only, most commonly the Index of Dissimilarity and the associated Index of Segregation, and are usually calculated at a single spatial scale, that of the smallest areal units available in census or other data collections—in this case Sydney's 9,098 neighbourhoods. These indices of dissimilarity and segregation suffer from several major disadvantages. First, as made clear by Carrington and Troske (1997), they are likely to be over-estimated, perhaps substantially, where the spatial units deployed have relatively small numbers of individuals in each—as is the case here—because they confound systematic and random variation. (For comparisons of application of the standard segregation indices and the modelling approach used here, see Johnston *et al*., 2016b.) Secondly, they have no basis in statistical theory, so that it is not possible, with any degree of certainty, to establish whether any one value is significantly different from another by more than chance. To establish whether one generation in an ancestry group is more segregated than another, more formal measurement methods are required.

A third disadvantage is that analyses of segregation at only one scale take no account of that at another, larger, scale within which the units being analysed are nested. This issue was raised several decades ago in a pioneering text on spatial analysis that has gone largely unremarked since. Duncan *et al.* (1961, p.84) reported that 'if one system of areal units is derived by the subdivision of the units of another system, the index computed for the former can be no smaller than the index for the latter, and usually will be larger', a point generalised later by Tranmer and Steel (2001). It may be that analysis at the neighbourhood scale suggests that a group is highly segregated, but the neighbourhoods where it is clustered are themselves concentrated in a particular region of the city, within which they are evenly distributed.

Once segregation has been measured and taken into account at the regional scale, therefore, there may be no further segregation at the finer neighbourhood scale. This point is illustrated by the distributions in three ideal-typical small cities shown in Figure 1.

<Take in Figure 1 around here>

Each is divided into six regions and each region contains four neighbourhoods; all neighbourhoods have a population of 100 and the numbers shown in the diagrams are for the minority group. In the first case (the city on the left side of the figure), all 480 minority group members are concentrated in two of the six regions, and they are evenly distributed across those regions' eight neighbourhoods. If segregation was measured at the neighbourhood scale alone, it would appear high, but if it was measured at both scales then, as Duncan *et al.* (1961) suggested, there would be substantial segregation at the regional scale but no additional segregation by neighbourhoods. By way of contrast, the second (centred) example in Figure 1 shows segregation at both scales: the minority group is concentrated into just three of the six regions, but in each of those it is more numerous in some neighbourhoods than others. Finally, in the third example on the right side of the figure, there is no segregation at the regional scale—there are 100 members of the minority group in each—but there is considerable segregation at the neighbourhood scale within each region.

The multi-level modelling method deployed here, set out in detail elsewhere (Jones *et al.*, 2015), counters those disadvantages and produces an index of segregation—the Median Rate Ratio (MRR)—for each generation in each ancestral group at each spatial scale. An index value of 1.0 indicates no segregation (that is, an even distribution). Following standard procedures (Cohen, 1998) MRR values greater than 4.5 indicate very substantial segregation;

those between 2.5 and 4.3 and between 1.5 and 2.5 respectively indicate medium and small levels. Each MRR value is net of any segregation identified at a larger spatial scale. MRRs can also be evaluated in a way similar to standard assessments of statistical significance; based in Bayesian statistical procedures, each ratio has associated Credible Intervals (CIs). These allow an assessment of both whether the observed MRR value is significantly larger than 1.0 and also whether one observed value differs significantly from another (for example, whether first-generation Italians are more segregated than their second-generation counterparts, for example, and whether first-generation Italians are more segregated than first-generation Greeks). A technical appendix specifies the model used in the analysis.

As well as the MRR values, the covariance matrices at the heart of the multi-level modelling procedure can also be used to generate matrices of correlation coefficients—interpretable in the same way as those obtained in applications of the general linear model—for each pair of distributions. These can be used to evaluate the degree to which two groups are concentrated in the same parts of the city. It could be, for example, that first- and second-generation Indians have similar MRR values but those two distributions are only weakly correlated—which would indicate that they are equally segregated at the designated scale, but have congregated in different sets of areas.

Segregation analyses I: cartographic representations

Although the main analytical contribution of this paper involves the novel use of the multi-level modelling approach to uncovering the intensity of segregation at various spatial scales, it is initially informative to portray and describe some of the main features of the geographies of the nineteen groups. That each ancestral group is concentrated into particular, and in general different, parts of Sydney is readily illustrated by maps of their distributions using the smallest of the four scales deployed in the analyses here—the neighbourhoods—as exemplified in Figures 2 and 3.

<Take in Figures 2a–c and 3a–c around here>

For each map we have divided the neighbourhoods into quartiles of the group population so as to portray the degree of concentration. Thus, for example, Figure 2a shows the distribution of first generation Greeks. The first quartile—Q1—comprises the smallest number of neighbourhoods containing one quarter of those individuals (that is, one-quarter of 54,666 people—Table 1); Q2 comprises the smallest number of neighbourhoods containing the next quarter; Q3 the third quartile and Q4 the fourth: those neighbourhoods with no Greek residents are separately identified.[2]

Figures 2a and 2b both show a large number of neighbourhoods with no Greek residents and a relatively small number, in the city's southeast sector, of Q1 neighbourhoods where both first- and second-generation Greeks are concentrated. That core Greek enclave is also evident in the map of third-generation residents (Figure 2c) but there is also a suggestion of wider dispersal across several separate parts of Sydney for those 22,694 individuals than there is for the first two generations. Similar patterns are shown in Figures 3a–c for Lebanese; all three generations are clustered into regions to the west of the city, but the third generation appears to be more widely distributed across a greater range of neighbourhoods.

Neighbourhood clustering

Although maps give a general impression of distributions the degree of concentration is not readily evaluated from them in any formal sense, particularly since the size of the generations within groups vary considerably. The maps can, however, be generalised. If a group was in no way concentrated into particular Sydney neighbourhoods, then the number of neighbourhoods would be the same in each of Q1, Q2, Q3 and Q4. The more clustered its members are into certain areas, however, the fewer of the 9,098 neighbourhoods there will be in Q1 and thus the more segregated the population. For example, if a group was evenly distributed across the 9,098 neighbourhoods, with only a small amount of random variation about the mean number in each, then each quartile would contain one quarter of the neighbourhoods (that is, 1,275). If the group is clustered into a small proportion of the neighbourhoods, on the other hand, then Q1 would comprise fewer of them. The smaller the number of neighbourhoods in Q1, therefore, the more spatially concentrated a group's members are. If Q1 comprised 300 neighbourhoods, for example, then one-quarter of them were concentrated in just over three per cent of neighbourhoods; if Q1 and Q2 together comprised 800 neighbourhoods, then one-half of the group were concentrated in nearly nine per cent. Thus, for example, in Table 2a one-quarter of first-generation Dutch residents were concentrated in 575 neighbourhoods (6 per cent only of all neighbourhoods), whereas one-quarter of all first generation Poles were in just 109 of the neighbourhoods (just 1 per cent).

<Take in Table 2a–b around here>

Tables 2a–b give the number of neighbourhoods in each quartile plus the mean number of group members in those neighbourhoods. The latter information is valuable for comparative purposes because of differences in the size of the generations across groups. For example, Q1 for first-generation Indians comprises 231 neighbourhoods, whereas for the second

generation it comprises 247, suggesting a similar degree of concentration. But the first generation of Indians is five times the size of the second generation (Table 1), so whereas each of the 231 Q1 neighbourhoods contained a mean of 122 first generation Indians (on average comprising 27 per cent of a neighbourhood's 477 residents), for the 247 Q1 neighbourhoods for the second generation that average is only 22 Indians. The core neighbourhoods in the Indian enclaves are more densely occupied by Indians in the first generation (they form, on average, about one-quarter of the population in each of those 231 neighbourhoods) than those in the second (only some 4.6 per cent on average of the population of the 247 neighbourhoods are second-generation Indians). This finding does not necessarily imply greater segregation of the first generation, however. The number of neighbourhoods in Q1 for the second-generation Indians suggests that they are as concentrated spatially as their first generation counterparts. The two generations do not differ in their spatial concentration into particular neighbourhoods, but on average members of the second generation live in ethnically more diverse neighbourhoods; each generation appears to be a segregated from the general population as the other, but their neighbourhood contexts differ.

For comparison, Table 2b also gives the data for those with no overseas ancestry, identified here as Australians. Only six of the 9,098 neighbourhoods had no Australians present, and Q1 for that map comprised 1,122 neighbourhoods, 12 per cent of the total, with a mean of 205 Australians in each. Some 4,233 neighbourhoods were in Q4, with an average of 54 Australians living there. Thus Australians were not evenly distributed through Sydney, but were concentrated to some extent in certain neighbourhoods. They were much less concentrated than any generation of any of the ancestral groups examined here, however, with the exception of third-generation UK and Irish group members (Table 2a). In each of those latter cases the number of neighbourhoods in each quartile group was very similar to that of the Australians: members of the third-generation ancestral groups from the British Isles were as widely distributed across Sydney as members of their ‘host society’, suggesting complete economic integration and socio-cultural assimilation. Members of the first generations from the UK and Ireland, as well as second-generation settlers from the UK, were also almost as widely distributed as their Australian counterparts. Second-generation Irish were relatively few in Sydney, however, and they were totally absent from 70 per cent of the neighbourhoods. Nevertheless, there was little evidence of their spatial concentration in the remaining neighbourhoods, as shown by the average number in each neighbourhood across the four quartiles.

None of the other ancestral groups has a distribution, for any of its three generational categories, that even approaches those of the three groups just discussed in terms of its spread across neighbourhoods. If each was evenly distributed across the 9,098 neighbourhoods, there would be 2,275 in Q1: the largest is just 739 for third-generation Germans. For the European groups (all shown in Table 2a), four of the seven have less than 500 neighbourhoods in Q1 for their first generation, indicating considerable concentration in particular parts of Sydney, whereas for the Asian groups having as many as 200 neighbourhoods in Q1 is rare (Table 2b), and applies only to the largest groups—first- and second-generation Chinese and Indians, first-generation Filipinos, and all three generations of Lebanese. For every ancestral group, and each generation within it, the number of neighbourhoods increases from Q1 through to Q4, suggesting that whereas a substantial proportion of the generation’s members were clustered into relatively small enclaves (as suggested by Figures 2-3), the remainder were relatively widely spread in small numbers across a larger number of neighbourhoods:

approximately half of all neighbourhoods had an average of six first-generation Indians, for example, contrasting with an average of 122 in each of the Q1 neighbourhoods.

Turning more specifically to differences in the degree of clustering between generations within any one ancestral group, if, as hypothesised, the second- and third-generations were less segregated than the first, then the number of neighbourhoods in Q1 should increase across the three generations and the average number in each of those neighbourhoods should decline: there should be more neighbourhoods across which the third-generation were spread, and they should contain fewer group members, than for the first-generation enclaves. As discussed above regarding Indians, however, there is no strong evidence to sustain the first part of that claim; with many groups the number of neighbourhoods in Q1 differs little, especially between the first and second generations. Thus, for example with Indians, Q1 for the first generation comprised 231 neighbourhoods and 247 for the second; there were many fewer for the third generation, but this was very much smaller than the first two. There is, however, stronger evidence supporting the second part of the claim: on average there were fewer second- and third-generation residents per Q1 neighbourhood than for the first generation. Where there were only small numbers in a group they did not dominate the local populations, as was the case with first-generation residents, but spatially those small numbers appear to have been just as concentrated in a few neighbourhoods as their larger predecessor generations.

Regional clustering

Table 2 summarises the maps of ethnic group generational distributions at the neighbourhood scale. As previously noted, however, earlier work has shown that each group is also strongly segregated at the regional scale too (Johnston *et al.*, 2016a). Does that apply to each within-group generation, or are succeeding generations less segregated at the regional scale; is the second generation more widely distributed across Sydney than the first, and the third more widely than the second? To answer this, the analyses reported in Table 2 for the neighbourhood scale are repeated in Table 3 for the regions—with the average number of residents in each region omitted.

There are 41 regions and so if each generational group was evenly distributed through Sydney at that scale there would be 10 regions in each of the quartiles. This is far from the case for every group—even for those with Australian ancestry, who are less unevenly distributed than any other group but nevertheless half of them lived in just 14 of the 41 regions. Of the ethnic ancestry groups, most are concentrated in just a few regions; only for those with UK, Irish, German and Dutch ancestry are there as many as five regions in Q1—one-quarter of the members of each of those groups lived in just one-eighth of Sydney's regions, and one-half in around 30 per cent. For most of the remaining groups, one-quarter of their members are concentrated in no more than four regions.

All groups are substantially concentrated in a few regions of Sydney, therefore, and there is little evidence of less segregation at that scale across the three generations. In some cases, there is slightly less concentration of the third than the first and second generations—the Italians and Chinese, for example—but this is only marginal. The overall conclusion is clear; Sydney's ancestral groups were all strongly concentrated in just a few regions within the urban mosaic—their third generations as much as their first. And, as Table 2 has shown, within those regions they are concentrated into particular neighbourhoods.

Segregation analyses II: measuring segregation

With the exception of the longest-established ancestral groups—those from the UK and Ireland—these descriptive summaries of the mapped geographies of ancestral groups in Sydney have provided strong evidence of their clustering in particular parts of the city, at both macro- and micro-scales. It was unclear however whether within each ancestral group those in the second- and, where it was large enough for a clear picture to be obtained, the third-generation are somewhat less segregated than those in the first generation who were born overseas. To provide more robust evaluations of the hypotheses underlying this exploration of Sydney's ethnic geography, and in particular to address the issue of scale in the intensity of clustering, we turn to our multi-scalar procedure for quantifying the degree of residential separation of each generation within each ancestral group.

Patterns of segregation by generation

To evaluate the degree of segregation of three generations within Sydney's ancestral groups we have the MRR value for each ancestral group at each of the four scales. That for the regional scale indicates the intensity of any deviation from a random distribution across the city's 41 regions. That at the next scale indicates the intensity of any deviation across the 217 districts net of—that is, within—the 41 regions; at the next scale it gives the intensity across the 558 suburbs, net of that within the 217 districts; and finally we establish the intensity across the 9,098 neighbourhoods net of any segregation at the suburban scale.

The MMR values for each generation in each group, at each of the four scales, are in Table 4; where they are based on a relatively small group size (notably some of the third-generation Asian groups) they have been underlined to indicate their unreliability.

<Take in Table 4 around here>

As in earlier work on whole-group segregation in Sydney and elsewhere (for example, Johnston *et al.*, 2016a; Manley *et al.*, 2015), in general the MRR values are higher at the macro- and micro-scales (regions and neighbourhoods) and less so at the two intermediate scales (districts and suburbs). This finding is in line with the multi-scale residential-decision-making process outlined in those earlier papers: individuals and households are either attracted to or directed towards particular large-scale sections of the city and within those they cluster in particular small neighbourhoods. The relative size of the MRR values indicates the extent of congregation at those scales. (All of the MRR values are significantly greater than 1.0—that is, their 5%CI values are greater than 1.0—indicating more segregation that would be expected with a random distribution of the group's members across the relevant set of areal units.)

Unsurprisingly, the lowest MRR values at all scales are for the Australians (those Sydney residents claiming no extra-Australian ancestry) and those with UK and Irish ancestries. They are widely distributed throughout the city's regions, districts, suburbs and neighbourhoods. Relatively low MRR values are also typical of most of the European ancestral groups, more so at the regional than at the neighbourhood scale. Thus those with Dutch and German ancestry—but not Polish—are also relatively evenly distributed through the city's 41 regions. The Asian ancestral groups, on the other hand, are much more clustered, with all of their

MRR values at that macro-scale in excess of 2.0 and a majority greater than 4.3, and with similar large values at the neighbourhood scale also. The greatest segregation levels, however, are reported for the relatively small Jewish group, whose members—in all three generations—are strongly clustered in a very small number of the city's regions and, within them, in a few neighbourhoods. (A map showing the distribution of all those claiming Jewish ancestry is in Johnston *et al*., 2016a.)

Those of Chinese ancestry stand out as among the least segregated at the neighbourhood level, except in the third generation, and are among the least segregated at region, district and suburb levels. The history of the Chinese presence in Australia is different from that of other non-English speaking background immigrants (Chin, 1975). As a result of the gold rushes, there were some 29,000 ethnic Chinese in Australia at the time of Federation in 1901. Although their entry was restricted after that by the White Australia policy, nevertheless numbers increased again during the Sino-Japanese and Pacific wars of the 1930s and 1940s. Thus while contemporary first and second generations represent those of Chinese ancestry from Vietnam during the 1970s, and the first generation largely skilled immigrants from Hong Kong and mainland China during the 1980s and since, the third generation represent a long established group as reflected in their distribution in suburban to regional with relatively few more segregated at the neighbourhood level.

Turning to differences in segregation levels across generations, the initial conclusion to be drawn is that the patterns are not consistent with the underlying hypothesis—that later generations should be less segregated than earlier ones. Indeed, at the regional scale for most groups exactly the opposite is the case: members of the second generation are more segregated than those of the first, and those in the third generation more than those in the second. At first glance, therefore, the general theory of inter-generational desegregation appears not to apply to most of Sydney's ancestral groups. However, this is at the macro-scale, so what those MRRs indicate is that, across all three generations, members of each ancestral group tend to be concentrated in particular city regions only; whilst members of later generations leave both the parental home and, perhaps, neighbourhood they still remain in the same region of the metropolitan area.

Those regions—as suggested by Figures 2 and 3—are likely to be the same parts of the city, therefore, a suggestion that can be assessed by the second set of output, the correlations between the distributions for each group's three generations (Table 5).

<Take in Table 5 around here>

For most of the groups the correlation between each pair of generations at the regional scale is large, especially that between the first and second generations; of those eighteen correlations only one is less than 0.75. The exception is the correlation for the Poles: many in the first generation arrived in Australia as displaced persons, and most of those in the second generation now resident in Sydney are descendants of that group. A second wave of Polish immigrants began in the 1980s (Forrest & Kusek, 2016). Some, but by no means all, of the correlations between the first and third generations and between the second and third are somewhat smaller. There is, thus, a strong tendency across all of the ancestral groups for members of each of their three generations to be clustered in the city's same macro-regions, but with some evidence that members of the third generation are slightly less so than their predecessors.

Turning to the micro-scale of the 9,098 neighbourhoods, again there is no evidence from the MRR values that the second and third generations are less segregated than the first—quite the contrary. Although some of the values for the third generation shown in Table 4 are not robust because of the small populations to which they refer, even with the ancestral groups with large second- and third-generation components (Dutch, German, Greek, Italian, Maltese, and Lebanese) the MRR values for the second generation are larger than those for the first, and those for the third generation are larger still. But are those differences statistically significant? Table 6 shows the MRR values along with their High and Low CI values at the macro- and micro-scales for those six ancestral groups, with MRR values for a generation that are significantly different from those for the previous generation underlined.

<Take in Table 6 around here>

In all cases where there is a significant difference the MRR for the later generation is higher than that for the earlier one. At the regional scale there are few significant differences: only between the first- and second-generations for the Dutch, Germans and Maltese are the latter generation significantly more segregated than the former. There are more significant differences at the neighbourhood scale, however: for all six groups, the second generation is significantly more segregated than the first and for all but the Dutch and Germans the third generation is significantly more segregated than the second.

Turning to the correlations, the pattern at the neighbourhood scale is very different from that for the regions (Table 5). Very few of those between the distributions of the first and second generations are substantial, with only three above 0.6—and one of those is for the Jewish group. There is also a major division between the more recent immigrant ancestral groups—

those from Asia and the Middle East—and those (all from Europe) that are longer-established in Australia; the smallest for the former group is 0.42, the largest for the latter (excluding the Jewish group) is 0.26. Indeed, all five correlations for those northern European groups, including the British and Irish, are virtually zero, indicating that however segregated each group is from the rest of the population members of the two generations are not clustered together in the same micro-scale neighbourhoods.

An absence of virtually any correlation between the distributions of the generations is a general characteristic of the correlations of the first-with-third and second-with-third generations in Table 5, although given the small size of the third generation Asian ancestral groups that is not altogether surprising. However, there are fairly strong correlations between the patterns for the four southern European ancestral groups. Although neither of those generations appears to share space with the relevant first generation, the two later generations congregate together, whereas many more of the second generation have moved away from their first-generation parental neighbourhoods.

Discussion and conclusions

The hypothesis set out at the start of this paper—derived from general appreciations of the literature on migrant group integration and assimilation—that within ancestral groups second generations should be less segregated than first generations, and third generations less segregated still, has been largely rejected by these analyses of the geography of nineteen groups in Sydney in 2011, which uses a more sophisticated, multi-scalar modelling procedure to assess segregation than is common in most analyses. As anticipated, all three generations of those claiming UK and Irish ancestries are relatively evenly distributed through the city's residential mosaic, alongside those claiming Australian ancestry. But for the remaining groups, most of whose original members entered Australia after World War II with many arriving in the last four decades only, there is very little evidence that segregation decreased across the generations.

That conclusion reflects the greater sophistication of the analyses reported here, in contrast to most explorations of the intensity of segregation. The MRR values provide much more information about the intensity of segregation of any group; whether there are significant differences between generations in that intensity within each group, and at which scales; whether there are significant differences between groups and their generations, and at which scales; and the degree to which different generations within a group are concentrated in the same areas, at which scales. By recognising that residential location decision-making is very much a multi-scalar process, and analysing the outcomes accordingly, the MRR values reported here have led to one substantial, important conclusion. With the exception of the long-established settler groups, mainly from the British Isles, all of Sydney's ancestral groups are concentrated in a few of the city's major regions—across all three generations. Whichever regions the first generation of residents move to, they and their successors then largely remain there. They may spread out within those regions, but relatively few of the second and third generations move beyond them into other regions. Once enclaves have been established in particular parts of Sydney they tend to become the relevant group's permanent home, albeit with later generations than the first concentrated in different neighbourhoods within those regions. This finding, in stark contrast to the traditional models of assimilation, has important consequences for the literature of residential sorting and mobility, pointing to a far 'stickier' spatial attachment to the enclave cores than had previously been supposed.

But what of the neighbourhoods favoured by each of the ancestral groups within their selected regions? Here the ‘theories’ linking economic integration and socio-cultural assimilation to residential location are clear: with each succeeding generation segregation should decline and its members become more widely scattered through multi-ethnic neighbourhoods. The MRRs reported here do not support that argument, however. If anything, with segregation into regions, districts and suburbs held constant, for all of the European and Asian ancestral groups analysed here the intensity of neighbourhood segregation increased from the first to the second generation, and then from the second to the third. The three generations were not concentrated in the same sets of neighbourhoods, however; they occupied different spaces at that scale within their preferred regions, but the intensity of the segregation was as great if not greater. Each generation is as segregated as the others, but later generations are segregated in different neighbourhoods from their predecessors—and those neighbourhoods where the second and third generations are concentrated are ethnically more diverse. Members of each generation within an ancestral group are as segregated from the total population (who form the baseline comparator in the calculation of MRRs) at both regional and neighbourhood scales, but at the latter scale—as shown by the descriptive analyses of the mapped distributions in Table 2a—they form a smaller component of each neighbourhood’s population.

The multi-scalar approach to segregation analysis adopted here has thus raised important questions regarding the structure of residential mosaics in multi-ethnic, multi-cultural cities—not least asking whether Sydney’s pattern is replicated elsewhere. One element of these findings is entirely consistent with a multi-scale residential location decision-making process: once a group is established in particular regions within a city it tends to remain concentrated there. But within those regions, concentration in particular neighbourhoods characterises all three generations—although not the same neighbourhoods. Herein lies the foundation for further studies of the detailed geography not just of Sydney but of a wide range of other cities that share its experience of recent decades.

Appendix: the model specification for a three-level Poisson model

Jones *et al.* (2015) discuss the general specification the Poisson multilevel level model for estimating the degree of segregation. Here, in practice, we fit a five-level random-effects Poisson model with people hierarchically nested in neighbourhoods, suburbs, districts and regions (the discordance where the number of levels is one greater than the number of hierarchical entities is explained below). To outline the form of the model that was used, while saving space, we show the formulation for two ethic groups—the Australians and the Jewish population—the latter being distinguished by generations—for just two geographical scales; SA1 and SA2. This would require a three-level model:

$$O_{ijk} \sim Poisson(\pi_{ijk})$$

$$Log_e(\pi_{ijk}) = Log_e(E_{ijk}) + \beta_{1jk}Australian_{ijk} + \beta_{2jk}Jewish1st_{ijk} + \beta_{3jk}Jewish2nd_{ijk} + \beta_{4jk}Jewish3rd_{ijk}$$

$$\beta_{1jk} = \beta_1 + v_{1k} + u_{1jk}$$

$$\beta_{2jk} = \beta_2 + v_{2k} + u_{2jk}$$

$$\beta_{3jk} = \beta_3 + v_{3k} + u_{3jk}$$

$$\beta_{4jk} = \beta_4 + v_{4k} + u_{4jk}$$

$$\begin{bmatrix} v_{1k} \\ v_{2k} \\ v_{3k} \\ v_{4k} \end{bmatrix} \sim N(0, \begin{bmatrix} \sigma^2_{v1} & & & \\ \sigma_{v12} & \sigma^2_{v2} & & \\ \sigma_{v13} & \sigma_{v23} & \sigma^2_{v3} & \\ \sigma_{v14} & \sigma_{v24} & \sigma_{v34} & \sigma^2_{v4} \end{bmatrix})$$

$$\begin{bmatrix} u_{1jk} \\ u_{2jk} \\ u_{3jk} \\ u_{4jk} \end{bmatrix} \sim N(0, \begin{bmatrix} \sigma^2_{u1} & & & \\ \sigma_{u12} & \sigma^2_{u2} & & \\ \sigma_{u13} & \sigma_{u23} & \sigma^2_{u3} & \\ \sigma_{u14} & \sigma_{u24} & \sigma_{u34} & \sigma^2_{u4} \end{bmatrix})$$

$$Var(O_{ijk}|\pi_{ijk}) = \pi_{ijk}$$

where O_{ijk} is the long stacked vector of the observed count for 'individuals' i in SA1j in SA2k. The other observed variables are the expected counts (E_{ijk}) for the each ethnic generation group if their numbers were distributed evenly according to the total population size of the neighbourhood. There are also four separately coded dummy (0/1) variable (e.g. $Jewish1st_{ijk}$) that identify which count represents which ethnic group in which generation.

As is common with count data we assume that they come from an underlying Poisson distribution with a mean rate of π. However, it is the natural log of the underlying rate that is modelled and this is achieved by the use of an offset which is the log of the expected count with a coefficient constrained to 1 (McCullagh and Nelder, 1989). There are four intercepts in the model, β_1 gives the log average rate across Sydney for Australians, while β_4 is the equivalent average log rate for third generation Jews. We expect that each of these estimates will when exponentiated give the all-Sydney rate for the mean area as 1 as the sum of the observed counts will equal to the sum of the expected. Around these averages, differentials at each of the higher scales are allowed to vary so that v_{1k} give the differential for SA2k for Australians. If this value is positive there are more of such people than an even distribution suggests; while if the random differential is negative, there are less. Additionally there is another set of differentials at the SA1 level so that u_{4jk} is the differential for third generation Jews for SA1$_{jk}$ from SA2$_{k}$ which is itself a differential from the average (β_4) across Sydney for this group. In this way the observed values are 'decomposed' into an average and differentials at each scale in the hierarchy.

These differentials at each of the higher levels are assumed to come for a joint Normal distribution so that the variance σ_{v1}^2 gives the segregation for Australians at the Suburban scale and we can test whether this is different from the variance for first generation Jews, σ_{v2}^2. The higher-level covariance term (e.g. σ_{v12}) will give when standardized (by the product of the square root of the associated variances) the correlation for the differentials at that level between the two groups. There is another set of variance-covariances at the SA1 level which summarizes the within-SA2 between- neighbourhood differentials. The variances (e.g. σ_{u1}^2) on the main diagonal are our measure of segregation for neighborhoods (net of Suburb level segregation) and the covariances on the off diagonal give an estimate of the co-location over the generations and in comparison to the Australian population.

The final line of the specification states that the variance of the observed counts conditional on the underlying rate is equal to the underlying rate (the mean and variance of a Poisson distribution are always exactly the same). This allows the other estimates in this generalized linear model to take account of the Poisson stochastic nature of the underlying counts. In practice in this three-level model there is exactly the same set of units—known as the 'cells'—at level 1 and level 2; that is, each level 2 unit has exactly one level 1 unit. This views the aggregated counts at level 2 as consisting of replicated responses for individuals at level 1. This use of a pseudo-level is explained in Browne *et al*. (2005) in relation to the binomial model and allows the separation of the variance into exact Poisson at level 1 and over-dispersion at level 2 and level 3 so that the higher-level variances summarizes the 'true' differences between areas over and above those expected from a random variation due to the absolute size of the count. Further levels for Region and Districts will additionally require ethnic by generation differentials at each scale and associated variance-covariance matrices to assess segregation and correlation.

All of the models were estimated in MLwiN software as Fully Bayesian models by using MCMC procedures (Browne 2012; Jones and Subramanian 2014); this allows the degree of support for the estimate in the form of credible intervals to be obtained. As is common with Poisson models, a long run of the MCMC simulation was needed after a long burn-in preceded by an initial quasi-likelihood estimation. We examined via diagnostics the reasonableness of the between cell Normality assumption and this was met in all the analyses. The estimated higher-level variances are transformed to MRRs by using the formula given in Larsen and Merlo (2005).

NOTES

[2] To do this work, the neighbourhoods were arranged in order according to the number of first-generation Greeks living there. Q1 is then the number of neighbourhoods containing the first 13,667; Q2 the next 13,667 and so on.

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Table 1. The ancestral groups, and the numbers in each generation, analysed

Generation	First	Second	Third	Total
Irish	96,904	10,966	202,436	310,306
UK	374,461	77,516	634,473	1,086,630
Dutch	25,451	4,357	5,665	35,473
German	45,575	7,869	39,999	93,443
Polish	20,856	5,032	2,824	28,712
Jewish	6,233	1,282	608	8,123
Croatian	20,571	7,846	3,440	31,857
Greek	54,666	32,261	22,694	109,621
Italian	82,425	40,158	42,952	165,535
Maltese	23,611	8,955	8,946	41,512
Iraqi	29,937	7,498	150	37,585
Lebanese	78,502	47,374	12,195	138,071
Turkish	15,089	6,221	586	21,986
Chinese	278,654	68,060	4,996	351,710
Filipino	65,255	14,513	290	80,058
Indian	112,553	21,373	490	134,416
Japanese	12,075	1,563	155	13,793
Korean	41,155	7,212	62	48,429
Vietnamese	54,961	23,016	265	78,242
Australian	919,292			919,292

Table 2a. The number of neighbourhoods in each quartile of each generation-ancestral group distribution, with the mean number of members of that group in those neighbourhoods in brackets.

Generation	1	2	3	1	2	3	1	2	3
		UK			Irish			Dutch	
Q1	954	883	1,057	765	350	1,002	575	195	197
	(98)	(22)	(150)	(32)	(8)	(50)	(11)	(6)	(7)
Q2	1,490	1,368	1,494	1,256	604	1,425	884	312	333
	(63)	(14)	(106)	(19)	(5)	(36)	(7)	(3)	(4)
Q3	2,151	1,959	2,025	1,854	846	1,975	1,359	361	465
	(44)	(10)	(78)	(13)	(3)	(26)	(5)	(3)	(3)
Q4	4,449	4,047	4,462	4,291	952	4,361	2,343	404	512
	(21)	(5)	(36)	(6)	(3)	(12)	(3)	(3)	(3)
None	54	841	60	932	6,346	335	3,937	7,826	7,591
		German			Polish			Maltese	
Q1	735	307	739	109	211	120	345	188	180
	(16)	(6)	(14)	(48)	(6)	(6)	(17)	(12)	(12)
Q2	1,148	503	1,086	251	347	192	711	377	338
	(10)	(4)	(9)	(21)	(4)	(4)	(8)	(6)	(7)
Q3	1,671	652	1,590	482	414	233	1,190	638	581
	(7)	(3)	(6)	(11)	(3)	(3)	(5)	(4)	(4)
Q4	3,576	694	2,961	1,377	457	275	2,246	785	785
	(3)	(3)	(3)	(4)	(3)	(3)	(3)	(3)	(3)
None	1,968	6,942	2,722	6,879	7,669	8,278	6,852	7,110	7,214

	Croatian			Greek			Italian		
Q1	364	232	120	332	271	256	542	418	541
	(14)	(8)	(7)	(41)	(30)	(22)	(38)	(24)	(20)
Q2	693	423	203	757	607	537	1,185	903	983
	(7)	(5)	(4)	(18)	(13)	(11)	(17)	(11)	(11)
Q3	1,109	611	284	1,465	1,124	994	1,907	1,534	1,531
	(5)	(3)	(3)	(9)	(7)	(6)	(11)	(7)	(7)
Q4	1,958	694	328	3,729	2,428	1,815	4,381	3,050	3,072
	(3)	(3)	(3)	(4)	(3)	(3)	(5)	(3)	(3)
None	4,974	7,138	8,163	2,815	4,668	5,496	1,083	3,193	2,971

Table 2b. The number of neighbourhoods in each quartile of each generation-ancestral group distribution, with the mean number of members of that group in those neighbourhoods in brackets.

Generation	1	2	3	1	2	3	1	2	3
		Jewish			Iraqi			Lebanese	
Q1	47	21	15	69	67	8	220	196	202
	(33)	(15)	(10)	(108)	(51)	(5)	(89)	(60)	(15)
Q2	106	39	31	158	130	11	447	385	375
	(15)	(8)	(5)	(47)	(14)	(3)	(44)	(31)	(8)
Q3	217	79	46	373	269	12	1,051	835	656
	(7)	(4)	(3)	(20)	(7)	(3)	(19)	(14)	(5)
Q4	532	145	92	1,578	623	55	3,838	2,622	1,054
	(3)	(2)	(2)	(5)	(3)	(1)	(5)	(5)	(3)
None	8,196	7,853	8,914	6,920	8,009	9,012	3,542	5,060	8,163
		Turkish			Chinese			Filipino	
Q1	115	79	23	346	457	185	250	137	14
	(33)	(20)	(6)	(201)	(37)	(7)	(65)	(26)	(5)
Q2	364	199	42	808	823	310	713	353	24
	(10)	(8)	(3)	(86)	(21)	(4)	(23)	(10)	(3)
Q3	695	397	49	1615	1,423	415	1,406	708	24
	(5)	(4)	(3)	(63)	(12)	(3)	(12)	(5)	(3)
Q4	1,333	560	91	5,615	3,577	458	3,607	1,242	66
	(3)	(3)	(2)	(12)	(5)	(3)	(5)	(3)	(1)
None	6,591	7,863	8,893	714	2,818	7,730	3,122	6,658	8,970

	Indian			Japanese			Korean		
Q1	231	247	24	172	62	8	123	107	2
	(122)	(22)	(5)	(18)	(6)	(5)	(84)	(17)	(8)
Q2	666	522	38	366	112	12	364	231	5
	(42)	(10)	(3)	(8)	(3)	(3)	(28)	(8)	(3)
Q3	1,435	939	41	642	130	13	812	405	5
	(20)	(6)	(3)	(5)	(3)	(3)	(13)	(4)	(3)
Q4	4,527	1,729	83	1,084	173	55	2,381	642	48
	(6)	(3)	(2)	(3)	(2)	(1)	(4)	(3)	(1)
None	2,239	5,661	8,912	6,834	8,621	9,010	5,418	7,713	9,038

	Vietnamese			Australian
Q1	136	133	14	1,122
	(101)	(43)	(5)	(205)
Q2	272	250	20	1,587
	(51)	(23)	(3)	(145)
Q3	694	496	22	2,150
	(35)	(12)	(3)	(107)
Q4	2,836	1,513	65	4,233
	(5)	(4)	(1)	(54)
None	5,160	6,706	8,977	6

Table 3. The number of regions in each quartile of each generation-ancestral group distribution

Generation	1	2	3	1	2	3	1	2	3
		UK			Irish			Dutch	
Q1	5	6	6	5	5	6	5	4	4
Q2	7	9	7	7	7	8	7	7	6
Q3	15	9	10	9	10	8	8	8	10
Q4	14	17	18	20	19	19	21	22	21
None	0	0	0	0	0	0	0	0	0
		German			Polish			Jewish	
Q1	5	5	6	1	4	4	1	1	1
Q2	7	8	7	2	6	7	2	1	1
Q3	11	10	10	3	10	9	4	1	2
Q4	18	18	18	35	21	21	29	19	16
None	0	0	0	0	0	0	5	19	21
		Croatian			Greek			Italian	
Q1	4	3	4	3	2	3	4	4	5
Q2	6	10	7	4	4	4	7	6	7
Q3	11	20	9	11	7	8	9	10	11
Q4	20	8	21	23	28	26	18	21	18
None	0	0	0	0	0	0	0	0	0
		Maltese			Iraqi			Lebanese	
Q1	4	3	4	1	1	2	2	2	2

Q2	6	4	4	1	3	1	2	1	4
Q3	8	7	7	2	5	3	6	6	8
Q4	23	27	26	36	30	8	31	32	27
None	0	0	0	1	2	27	0	0	0
		Turkish			Chinese			Filipino	
Q1	2	1	2	4	4	5	2	2	3
Q2	4	3	4	5	5	7	8	4	4
Q3	7	6	6	6	6	9	7	8	8
Q4	28	29	19	26	26	20	24	27	15
None	0	2	10	0	0	0	0	0	11
		Indian			Japanese			Korean	
Q1	3	3	4	2	3	3	3	3	2
Q2	4	4	6	3	4	4	4	3	1
Q3	9	8	8	6	6	7	5	4	5
Q4	25	26	19	30	26	13	29	29	7
None	0	0	4	0	2	14	0	2	26
		Vietnamese						Australian	
Q1	1	1	1				6		
Q2	1	1	1				8		
Q3	4	4	4				10		
Q4	35	35	14				17		
None	0	0	21				0		

Table 4. The MRR values for each generation-ancestral group at each of the four scales (MRR values based on small populations are underlined)

Scale	Region			District			Suburb			Neighbourhood		
Generation	1	2	3	1	2	3	1	2	3	1	2	3
Australian	1.32			1.19			1.17			1.20		.
UK	1.44	1.30	1.46	1.15	1.15	1.27	1.13	1.11	1.21	1.31	1.53	1.28
Irish	1.62	2.15	1.47	1.21	1.54	1.27	1.18	1.43	1.21	1.58	5.60	1.32
Dutch	1.94	3.62	3.34	1.31	1.61	1.88	1.20	1.41	1.55	2.39	12.89	11.75
German	1.41	1.80	1.61	1.18	1.46	1.35	1.13	1.32	1.26	1.95	8.07	1.84
Polish	7.12	2.18	2.72	2.15	1.62	1.64	1.83	1.69	1.51	6.22	13.47	27.89
Croatian	1.72	2.13	2.16	1.66	2.18	2.53	1.45	1.93	2.47	4.00	8.62	25.87
Greek	2.37	2.99	2.71	1.43	1.67	1.79	1.39	1.63	1.76	2.34	2.64	4.47
Italian	1.52	1.71	1.42	1.33	1.55	1.56	1.29	1.45	1.43	1.85	2.09	2.24
Maltese	2.40	4.51	4.55	1.56	2.27	2.23	1.42	1.76	1.86	3.17	6.27	8.25
Jewish	18.66	90.06	61.52	2.58	3.71	1.18	3.64	13.97	13.53	8.11	26.21	67.62

Iraqi	9.02	12.85	<u>29.05</u>	3.16	4.15	<u>21.81</u>	2.17	3.01	<u>1.68</u>	6.46	8.62	<u>992.1</u>
Lebanese	3.67	5.30	4.22	1.71	1.98	1.91	1.52	1.68	1.80	2.79	3.14	7.78
Turkish	4.42	9.15	<u>20.68</u>	1.77	2.24	<u>1.54</u>	1.95	2.54	<u>5.09</u>	7.18	11.57	<u>*213.6*</u>
Chinese	2.55	3.05	2.27	1.61	1.67	1.45	1.48	1.50	1.53	1.70	1.93	16.1
Filipino	2.47	4.59	5.27	1.62	2.11	<u>1.22</u>	1.60	1.93	<u>1.18</u>	2.73	6.30	<u>246.9</u>
Indian	2.39	3.63	<u>2.31</u>	1.76	1.99	<u>1.55</u>	1.65	1.87	<u>1.59</u>	2.40	3.81	<u>165.6</u>
Japanese	4.96	5.94	<u>2.74</u>	1.78	2.63	<u>1.67</u>	1.64	2.03	<u>3.35</u>	6.26	41.7	<u>1097</u>
Korean	4.95	10.05	<u>34.99</u>	2.18	3.08	<u>2.18</u>	1.76	2.07	<u>5.60</u>	3.96	8.67	-
Vietnamese	5.05	6.69	*8.48*	2.26	2.66	*1.60*	1.76	1.98	<u>1.33</u>	3.63	5.34	<u>105.7</u>

Table 5. The correlations between the distributions of pairs of generations within each ancestral group, at each scale

Scale	Region			District			Suburb			Neighbourhood		
	FS	FT	ST	FS	FT	ST	FS	FT	ST	FS	FT	ST
UK	0.92	0.69	0.60	0.78	0.74	0.62	0.61	0.60	0.61	-0.04	-0.18	0.09
Irish	0.88	0.83	0.86	0.83	0.81	0.87	0.80	0.75	0.81	-0.02	-0.07	0.08
Dutch	0.88	0.84	0.90	0.84	0.79	0.88	0.77	0.77	0.85	-0.04	-0.06	0.19
German	0.79	0.73	0.78	0.65	0.69	0.78	0.65	0.51	0.72	-0.08	-0.24	0.12
Polish	-0.23	-0.42	0.67	0.26	0.09	0.51	0.51	0.12	0.30	-0.27	-0.19	0.21
Croatian	0.81	0.56	0.65	0.79	0.60	0.78	0.80	0.64	0.76	0.26	0.12	0.54
Greek	0.84	0.79	0.84	0.84	0.66	0.78	0.75	0.68	0.79	0.22	0.11	0.71
Italian	0.77	0.48	0.59	0.83	0.73	0.83	0.75	0.67	0.81	0.18	0.00	0.55
Maltese	0.91	0.86	0.90	0.81	0.77	0.81	0.65	0.69	0.74	0.08	0.03	0.48
Jewish	0.78	0.69	0.66	0.23	0.03	0.02	0.38	0.39	0.36	0.60	0.30	0.41
Iraqi	0.86	0.76	0.77	0.69	0.45	0.50	0.71	0.02	0.03	0.56	0.15	0.22
Lebanese	0.88	0.89	0.88	0.80	0.69	0.72	0.82	0.70	0.69	0.54	0.24	0.54
Turkish	0.87	0.84	0.86	0.49	0.23	0.19	0.80	0.72	0.68	0.53	0.67	0.52
Chinese	0.97	0.36	0.23	0.96	-0.23	-0.16	0.91	-0.23	-0.04	0.61	-0.05	0.07

Filipino	0.97	0.68	0.73	0.78	0.12	0.14	0.77	0.02	0.03	0.49	0.04	0.19
Indian	0.88	0.10	0.17	0.85	0.25	0.29	0.79	-0.14	-0.06	0.48	0.02	0.08
Japanese	0.84	0.04	-0.04	0.50	-0.10	-0.14	0.56	-0.24	-0.24	0.42	0.14	0.13
Korean	0.91	0.83	0.84	0.82	-0.01	0.01	0.68	0.12	0.14	0.50	0.07	0.09
Vietnamese	0.90	0.84	0.87	0.94	0.69	0.69	0.87	0.25	0.27	0.66	0.08	0.01

Key: FS – correlation between the first and second generations; FT – correlation between the first and third generations; ST – correlation between the second than third generations.

Table 6. The MRR values, with their associated low (5%) and High (95%) Credible Intervals, at the regional and neighbourhood scales, only, for selected ancestral groups. MRR values significantly different from those for the immediately higher scale are underlined.

	Region			Neighbourhood		
	LoCI	MRR	HiCI	LoCI	MRR	HiCI
Dutch						
First	1.69	1.94	2.30	2.32	2.39	2.46
Second	2.71	<u>3.62</u>	5.13	11.32	<u>12.89</u>	14.80
Third	2.52	3.34	4.69	10.45	11.75	13.24
German						
First	1.31	1.41	1.55	1.91	1.95	1.98
Second	1.56	<u>1.80</u>	2.14	7.40	<u>8.07</u>	8.81
Third	1.45	1.61	1.83	1.81	1.84	1.88
Greek						
First	1.98	2.37	2.96	2.29	2.34	2.40
Second	2.37	2.99	3.97	2.55	<u>2.64</u>	2.73
Third	2.18	2.71	3.54	4.24	<u>4.47</u>	4.71
Italian						
First	1.39	1.52	1.70	1.82	1.85	1.88
Second	1.51	1.71	1.99	2.04	<u>2.09</u>	2.14
Third	1.28	1.42	1.60	2.19	<u>2.24</u>	2.30
Maltese						
First	1.98	2.40	3.03	3.05	3.17	3.29

Second	3.21	4.51	6.80	5.77	6.27	6.83
Third	3.22	4.55	6.90	7.51	8.25	9.07
Lebanese						
First	2.80	3.67	5.11	2.71	2.79	2.87
Second	3.75	5.30	8.10	3.02	3.14	3.26
Third	3.08	4.22	6.16	7.16	7.78	8.46

Figure 1. Ideal-type segregation patterns

60	60	0	0
60	60	0	0
60	60	0	0
60	60	0	0
0	0	0	0
0	0	0	0

40	40	0	0
60	60	0	0
40	60	0	0
40	60	0	0
60	40	0	0
40	60	0	0

60	0	0	40
0	40	60	0
40	0	40	0
60	0	0	60
0	0	0	0
40	60	60	40

Figure 2a. The quartile distribution of first-generation Greeks at the neighbourhood scale

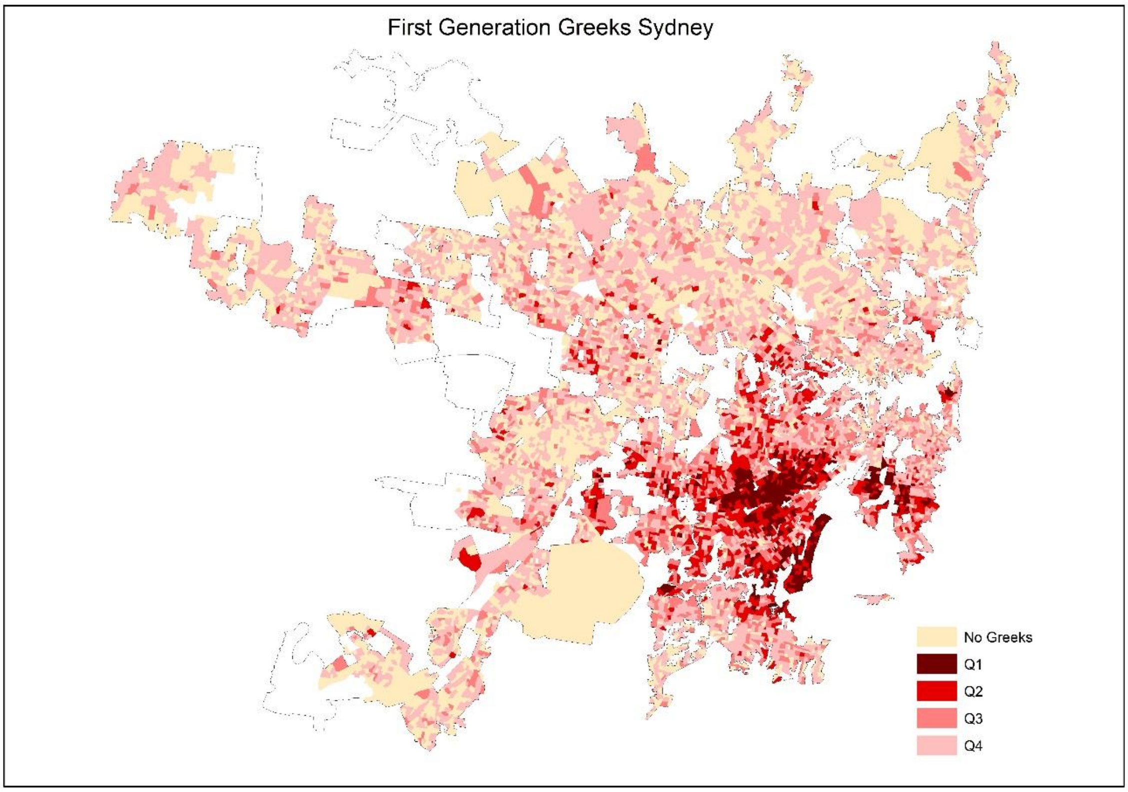

Figure 2b. The quartile distribution of second-generation Greeks at the neighbourhood scale

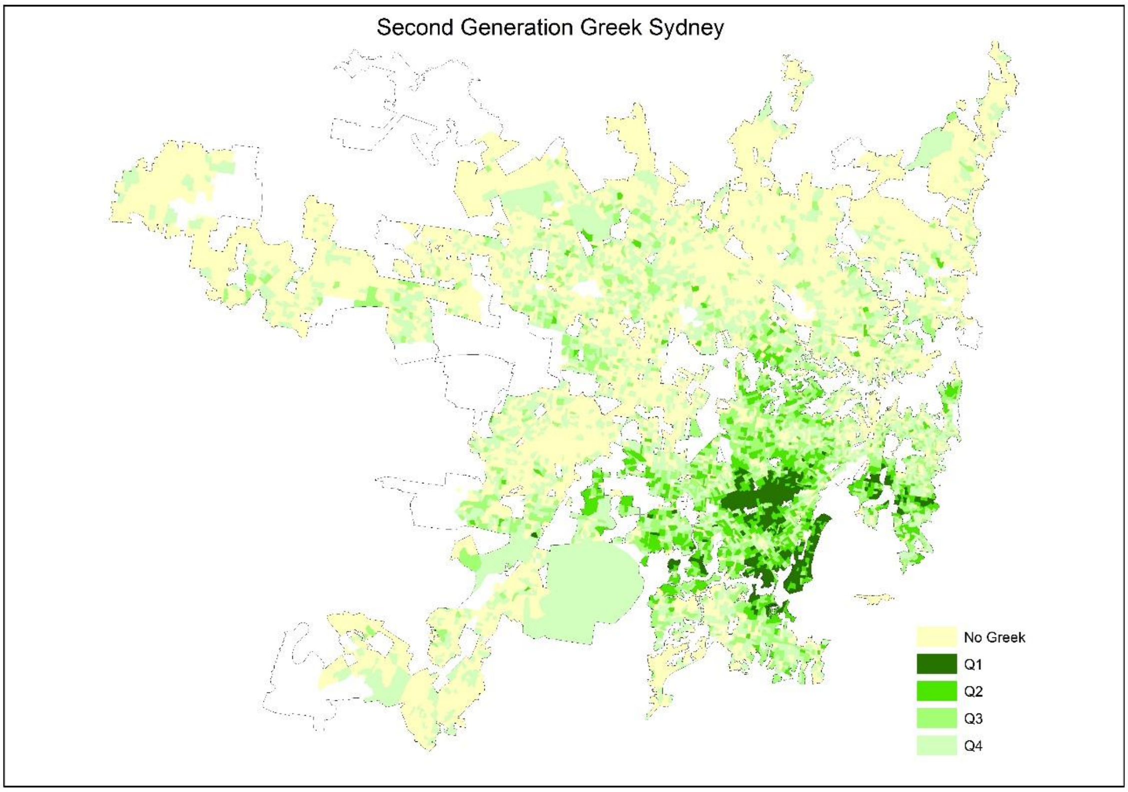
Second Generation Greek Sydney
No Greek
Q1
Q2
Q3
Q4

Figure 2c. The quartile distribution of third-generation Greeks at the neighbourhood scale

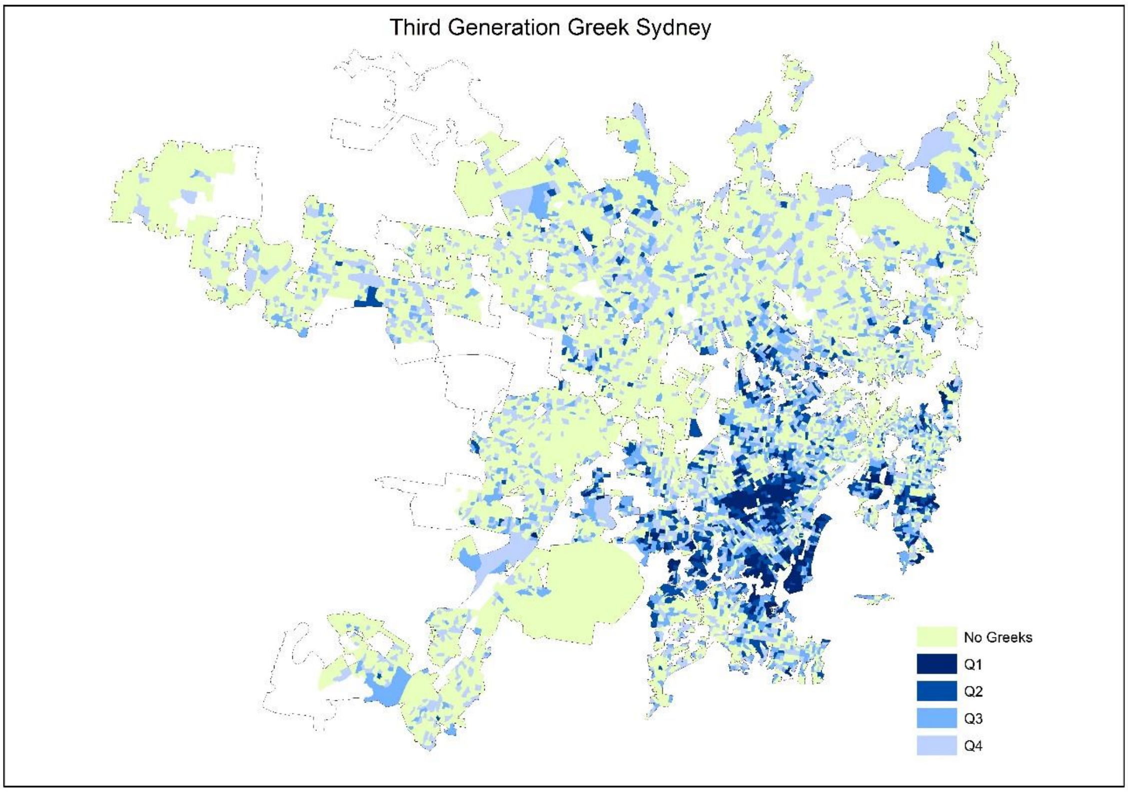

Figure 3a. The quartile distribution of first-generation Lebanese at the neighbourhood scale

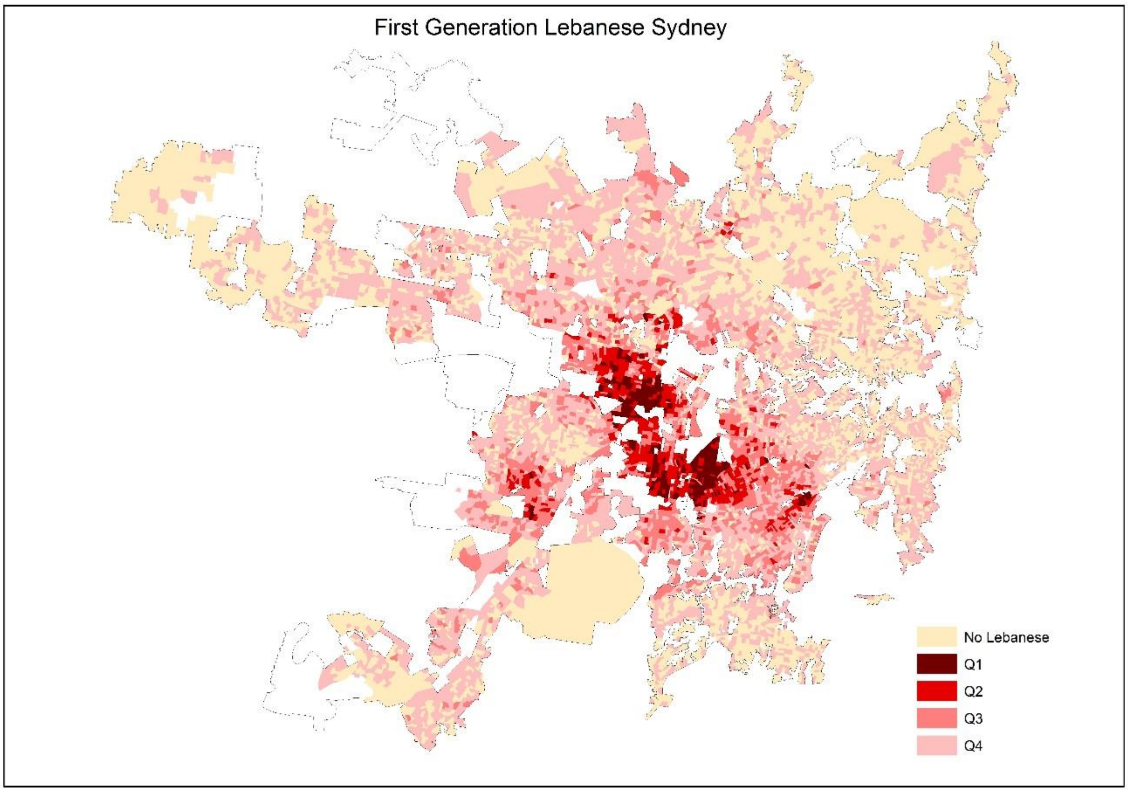

Figure 3b. The quartile distribution of second-generation Lebanese at the neighbourhood scale

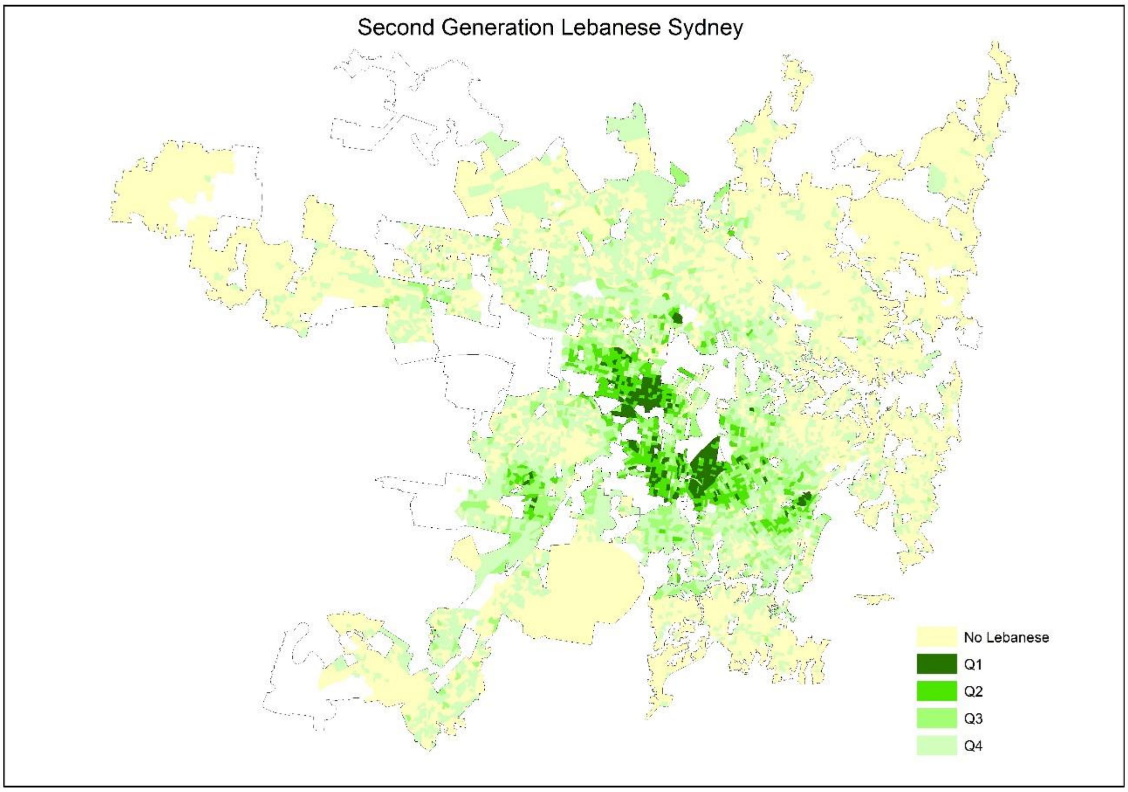
Second Generation Lebanese Sydney
No Lebanese
Q1
Q2
Q3
Q4

Figure 3c. The quartile distribution of third-generation Lebanese at the neighbourhood scale